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A Case Study on Partial Replacement of Fine Aggregate by Waste Tyre Crumb Rubber in Concrete

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ABSTRACT : This paper indicates the experimental look at at the consumption of refuse tyre crumb rubber in concrete in replacement for quality mixture in distinct probabilities at the side of using silica fumes as mineral admixture to regulate the bonding homes of the Rubberized concrete in a fine way. on this examine the waste tyre crumb rubber became used as a substitute for herbal first-rate aggregates and changed into examined for the mechanical homes of M30 grade concrete as according to IS 10262-2009. 3 one-of-a-kind homes of rubberized concrete had been examined specifically compressive strength, flexural energy and split tensile power. In keeping with the take a look at consequences it changed into noticed that there's lower in the compressive electricity, cut up tensile energy and flexural energy whilst the proportion of rubber content is elevated as compared to the nominal mix. the proportion replacement of herbal exceptional mixture With crumb rubber was five%, 10% and 15%

I. INTRODUCTION

The dumping of waste fabric is one of the key issues in the entire world. The dumping of the waste tyres is a chief count due to the fact this fabric could be very hard to degrade even after an extended time. Waste rubber is also used as raw material for rubber items. Concrete is made through manner of the composition of cement, coarse mixture and first-class mixture. Among all sorts of construction substances concrete is the maximum often used material. Due to which there is lower within the natural aggregates. There are numerous strategies which had been proposed for the consumption of waste tyre, one among them is the use of crumb rubber within the concrete as full or partial replacement of coarse aggregates or quality aggregates .but handiest restrained researches have been performed till now on the use of waste tyre crumb rubber in concrete.

Alteration of building materials has an critical position within the constructing sector. Numerous numbers of tries had been as a result made in the construction fabric field to get into use refused waste merchandise like broken used tyres, into precious and gainful items. success on this case can have an extremely good contribution closer to the decline of waste material dumping issues through usage of the waste materials as a uncooked depend for other production requirements. As dumping and burning of waste and discarded rubber tyres is a totally hard and pollution producing procedure.

Cement combination consisted of rubber may be proved realistic to use for fundamental and nonstructural motive, for example, lightweight concrete dividers, constructing exteriors and compositional components. The intake of crumb rubber in flimsy concrete is considered as conceivably vital street. the usage of crumb rubber with concrete can be development in the structuring of the wall because it will paintings as shock as well as sound absorber.

II. OBJECTIVE

The technique requires a extensive laboratory for analyzing the proportion of crumb rubber inside the practice of rubberized concrete .The cause of the examine was to understand the power conduct this is trade in compressive, flexural power and break up tensile energy of rubberized concrete with exceptional percentage of crumb rubber.

Parameters varied in Investigation as shown below:

- Firstly the replacement of fine aggregate using crumb rubber is done by 5% in the concrete.
- Then, replacement of fine aggregate is increased to 10% in the concrete.
- And, At last, 15% fine aggregate is replaced with crumb rubber in the concrete.

III. MATERIAL USED

1. **CEMENT** - OPC 43 grade cement is used for the experimental purpose and is investigated as per Indian Specifications IS: 12269-1987.



Fig.1 OPC Cement 53 Grade

2. **FINE AGGREGATE** - Aggregate having size 4.75 mm as maximum is used as fine aggregate.

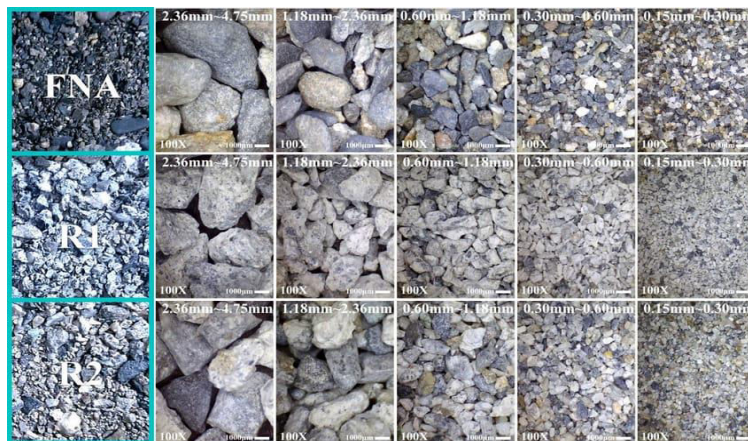


Fig.2 Fine and Course Aggregate

3. **COARSE AGGREGATE** - Aggregate having maximum 20 mm size is used as coarse aggregate.
4. **WATER** - Water used as per the IS: 456-2000 for mixing as well as used for curing of Concrete Cubes.
5. **WASTETYRE** - Crumb rubber having size between 0.075 mm to 4.0mm is used in the concrete.



Fig.3 Waste tyre crumb

Mix Proportion -

| Unit | Cement (kg) | F.A (kg) | C.A (kg) | Water (lit) |
|-------------|-------------|----------|----------|-------------|
| Cubic meter | 434.8 | 843.42 | 1074.08 | 170 |
| Ratio | 1 | 1.94 | 2.47 | 0.31 |

Mixdesign -

Mix design can be defined as the process of gathering the required ingredients in the required quantities in order to mix them in proper ratio to get the concrete having desirable strength, durability and workability. In this experimental investigation I have prepared a concrete having mix proportions of **M-30** which is tabulated below:



Fig.4 Crumb rubber Concrete Mixing

Mix Proportion -

The mix design was prepared with the help of specific proportion of mix design of m30 grade consist of cement, aggregate and water. The mix design was prepared as per IS Code: 10262-2009 to have 28days compressive strength of 28.66 N/mm². After that the fine aggregate was replaced with 5%, 10% and 15% crumb rubber by weight of fine aggregates.

| Content | Mix-1 (0%CR) | Mix-1 (5%CR) | Mix-1 (10%CR) | Mix-1 (15%CR) |
|------------------------------------|--------------|--------------|---------------|---------------|
| Cement kg/m ³ | 434.8 | 434.8 | 434.8 | 434.8 |
| Fine Aggregate kg/m ³ | 843.42 | 801.25 | 749.078 | 716.907 |
| Course Aggregate kg/m ³ | 1074.008 | 1074.008 | 1074.008 | 1074.008 |
| Water | 170 | 170 | 170 | 170 |
| Crumb Rubber | 0 | 42.17 | 94.34 | 126.51 |
| W/C Ratio | 0.31 | 0.31 | 0.31 | 0.31 |
| Admixture kg/m ³ | 3.319 | 3.319 | 3.319 | 3.319 |

Mix Proportion for Different % of Crumb Rubber

Preparation & Details of test Specimens -

In the present experimental the whole numbers of specimens casted had been seventy two. The cubes casted have been definitely 24 in quantity, of which each set of 6 cubes were meant for each percentage of crumb rubber (i.e. 0%, 5%, 10% and 15%). Out of 6 cubes, 3 cubes were examined after 7 days, and the alternative three cubes were examined after 28 days. Further 24 beams and 24 cylinders have been casted, of which every set of 6 beams and six cylinders were supposed for each percentage of crumb rubber. In those, every 3 beams and each three cylinders having one-of-a-kind crumb rubber percentage have been examined after 7 day Strength and 28 day respectively.

Test on crumb rubber Concrete Block:-

1. Compressive strength
2. Split Tensile Strength
3. Flexural Strength

1. Compressive strength Test

This take a look at allows us in determining the compressive strength of the concrete cubes. The received price of compressive Strength can then be used to evaluate whether or not the given batch of that concrete dice will meet the specified compressive Strength necessities or not. For the compression take a look at, the specimen's cubes of 15 cm x 15 cm x 15 cm had been prepared by way of the use of crumb rubber concrete as explained in advance. These specimens tested with the help of universal testing machine after 7 days and 28 days of curing. Load becomes carried out gradually at the rate of 140kg/cm² in keeping with minute until the specimens failed. Load at the failure became divided by way of location of specimen and this gave us the compressive strength of concrete for the given Sam.



Fig.5 Compressive strength of Concrete Block

Calculations -

Compressive Strength Test

The compressive strength of Crumb rubber concrete block size of 15 cm x 15 cm x 15 cm is obtained are given below

Target mean strength for 28 days for M20 concrete (f'_{ck}) = $f_{ck} + 1.65 \cdot s$

Formula for compressive strength is

$$\Sigma \sigma = P / A$$

Where, $\Sigma \sigma$ = Compressive Strength (N/mm²)

P = Maximum load (N)

Results of Concrete Cube Samples Containing Crumb Rubber -

| | Mix | 7 Days | 28 Days |
|---|---------|--------|---------|
| Compressive Strength N/mm ² | 0 % CR | 27.85 | 33.85 |
| | 5 % CR | 26.22 | 28.01 |
| | 10 % CR | 24.01 | 26.55 |
| | 15 % CR | 18.35 | 20.68 |

2. Split Tensile Strength

Split tensile strength is defined because the tendency of a Material to oppose an implemented forces attempting to pull it apart. The tensile energy of a material can be defined because the minimum amount of Force this is required to cut up that material. The cylinders of size 150 mm via diameter and 300mm through length that we've casted have been compacted in vibrators after which after de-moulding and curing them, the checks were performed on them after 7 and 28 days respectively to check there break up tensile strengths.



Fig.6 Split Tensile Strength

Calculations:-

this Formula is used to calculate Split tensile strength :

$$i. f_{ct} = \frac{2P}{\pi L D}$$

Where,

- P = maximum load in Newton applied
- L = length of the specimen (in mm), and
- D = CS dimension of the specimen

Results of Concrete Cylinder Samples Containing Crumb Rubber -

| | Mix | 7 Days | 28 Days |
|--|---------|--------|---------|
| Split tensile strength(N/mm ²) | 0 % CR | 7.2 | 8.5 |
| | 5 % CR | 6.08 | 7.33 |
| | 10 % CR | 5.68 | 6.44 |
| | 15 % CR | 5.35 | 6.01 |

3. Flexural Strength -

Flexural strength is defined as the tendency of the material to oppose its deformation when a specific amount of load is applied on it. It is also known fracture strength. The beams of size 10 × 10 × 50 cm that we have casted were compacted in vibrators and then after de-moulding and curing them the tests were conducted on them after 7 and 28 days respectively to check there flexural strengths.



Calculations -

$F = PL / (bd^2)$. Here F = Flexural strength of concrete (in MPa), P = Failure load (in N), L = Effective span of the beam (400mm), b = Breadth of the beam

Results of Concrete Beam Samples Containing Crumb Rubber -

| | Mix | 7 Days | 28 Days |
|---------------------------------------|---------|--------|---------|
| Flexural strength(N/mm ²) | 0 % CR | 11.8 | 13.03 |
| | 5 % CR | 9.70 | 10.03 |
| | 10 % CR | 8.91 | 9.83 |
| | 15 % CR | 7.03 | 8.49 |

1. For the concrete containing crumb rubber, the test results shows that with the addition of crumb rubber there is reduce in the value of compressive strength, flexural strength and split tensile strength.
2. The reduce value of compressive strength observed is range from 10% to 27%.
3. In case of split tensile strength there is reducing in strength the range of 8% to 25%. However there is little lesser reduction in split tensile strength comparing to compressive strength.
4. In case of flexural strength there is reduction in strength like compressive strength is reducing about 20% to 30%.

IV. CONCLUSION

According to experimental research, the utilization of rubber tyre as partial alternative of first-class aggregates has been utilized in three different proportions 5%, 10% and 15% based totally at the consequences, following conclusions are drawn:

1. As the percentage of crumb rubber is improved, the workability of the concrete additionally will increase.
2. The boom inside the workability also suggests decrease in the voids due to the betterment in the Compaction however due to the decrease in the different residences it is not good sized.
3. For larger percentage of rubber in concrete, the decline fee of compressive strength is higher than regular concrete.
4. Higher results have been received whilst 5% of rubber is used for substituting the natural aggregate in the rubberized concrete.
5. 5% substitute of crumb rubber proves noticeably well in compression, tensile and flexural energy and comply with the curvature of the conventional specimens all of the checks in M30 grade of concrete.
6. By replacing fine aggregate by crumb rubber safe for the environment.
7. Rubberized concrete is also used for insulation work like insulation from noise and heat. So it is able to be used as an insulating Material in partitions in residential in addition to business homes and as a noise insulator in theatres, cinema halls, noise evidence rooms and auditoriums and so on.

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